

During the evening of Sunday, August 26, 1900, while near Gapland, Md., on the east slope of the Blue Ridge Mountains (12 miles north of Weverton) I saw a most beautiful display of lightning without thunder; the flashes appeared in the southwest corner of the valley known as Middletown Valley, followed the Potomac River and mountains on the Virginia side, then passed to the Blue Ridge at Weverton and followed the mountain top, making a circuit of at least 60 miles, this appeared to occur twice, when gradually the flashes spread, as it were, to the valley, in appearance resembling the discharge of a roman candle. This most beautiful phenomenon lasted from about 7 to 10:30 p. m., and when near the house the light was so vivid that at times one could easily have read a book. An old resident remarked that whenever they had such "lightning storms" it purified the air, and the next day was always bright and clear.

This display of lightning without thunder recalls a thunderstorm that occurred several years ago in the Blue Ridge Mountains in the month of July. I was on a train going to Emmitsburg, Md.; when we changed cars at Rocky Ridge, the sky was heavily overcast with large cumulo-nimbus clouds. As we moved along by the side of the mountain, about 1 mile distant, a terrible thunderstorm, accompanied by high wind, burst before us. The lightning was so vivid as to be nearly blinding, and as the storm or clouds followed the mountains the lightning appeared to those on the train to leap from peak to peak, in fact several persons remarked "that mountain must be full of iron." The storm passed off over Emmitsburg and the sun came out as bright and hot as before.

#### THE FRENCH EDITION OF THE MONTHLY WEATHER REVIEW.

The publication of the MONTHLY WEATHER REVIEW, which began with the number for January, 1873, compiled by the present Editor, was soon recognized as an important means of bringing before the world a general summary of the work done by the Weather Bureau, at that time a part of the Signal Service. The enlargement of the REVIEW, in 1875, enabled it to include the results of observations by voluntary observers, and also notes and extracts from current meteorological observations, and it became widely recognized as a model for other nations to copy and improve upon. In 1878, Gen. A. J. Myer, the Chief Signal Officer, and head of the Weather Bureau, thought it important to try the experiment of translating the REVIEW into French and publishing an international edition. The labor and expense attending this experiment was subsequently found to be prohibitive, but the few copies of this edition that are still to be found in the libraries mark one of the many interesting episodes in the history of the Weather Bureau. Unfortunately, the copy of the French edition that formerly belonged to the library of the Weather Bureau has mysteriously disappeared, and the Librarian joins with the Editor in the hope that several of our numerous correspondents have, or know of, copies for sale or exchange. We would esteem it a favor to be apprised of the fact, so that we may be enabled to complete our files.

#### RAFINESQUE ON ATMOSPHERIC DUST.

In Science for August 10, 1900, Mr. Wm. J. Fox gives a complete table of contents, with occasional notes of Vol. I, No. 1, of Rafinesque's *Western Minerva, or American Annals of Knowledge and Literature*. This was published at Lexington, Ky., in January, 1821, and was to have been the first number of a long series, but some trouble with the printer unfortunately prevented any further publication.

Professor Rafinesque occupied a prominent place in American science. He was born of French parents in Turkey, in 1784, came to America in 1802, and spent several years making botanical collections. He went back to Europe and returned to New York in 1815, but was unfortunately wrecked on the coast of Long Island, where he lost the collections that represented twenty years of work. He was then, for a time, Professor of Botany in Transylvania University at Lexington, Ky., but soon removed to Philadelphia,

where he died in 1842. The periodical whose title is given above has a slight interest for meteorologists, in that it contains a letter on atmospheric dust, addressed to Governor DeWitt Clinton, Albany, N. Y., and which is the second article that Rafinesque seems to have written. At that time dust was considered as a matter that interested the geologist rather than the meteorologist, but the interest taken in this subject since the great eruption of Krakatoa, and especially, the demonstration that the presence of dust materially contributes to facilitate the formation of rain and snow, to increase the radiation and absorption of heat, and to affect the percentage of polarized light justifies the modern meteorologist in considering the dust floating in the air as being quite as essential a portion of the atmosphere with which he has to deal as is the moisture or any other variable component. It is customary to state with great precision the chemical constitution of the so-called dry air, but this term should now be modified and made more explicit by using the phrase "dry and dustless air." In his *Philosophy of Storms*, Boston, 1841, on page 36, Espy states that to his astonishment, it was much more difficult to secure saturated air by expansion in his nepheloscope after the air had been kept a long time, and had frequently been brought into the cloudy condition. We now know that this was due to the fact that by keeping the air quiet, and especially, by his frequent production of cloudy condition by expansion he must have almost wholly cleansed the air of dust, so that eventually he was experimenting with dustless air, thereby producing, as it seemed to him, a decided fall in the dew-point. He suspected that the water or glass of his enclosure attracted and condensed the particles of aqueous vapor; he had not then learned the importance of dust in facilitating condensation.

Although Rafinesque looked at the atmospheric dust from another point of view, yet, his views also have some interest in connection with the history of this subject. The *American Journal of Science* began with the publication of Volume I, No. 1, in July, 1818. In the fourth number of this first volume, published in June, 1819, Professor Rafinesque, who was at that time probably living in Lexington, Ky., published his first article "Thoughts on atmospheric dust." This gives results to which he had attained years before, viz:

That in general dust is falling at all times from the atmosphere; that atmospheric dust exists on the tops of the highest mountains; that a portion of it, if not all, is chemically formed in the atmosphere like snow, hail, meteoric stones, honey-dew, earthy rains, etc., by the combination of gaseous and elementary particles dissolved in the air; its formation is sometimes very rapid and its accumulation very thick in the lower strata of the atmosphere; it settles slowly to the ground in clear weather, but is quickly washed down by rain or snow; its accumulation in a quiet room varied from one-fourth of an inch to one inch in depth in the course of one year; but this was in a fleecy state and might by compression be reduced to one-third of this height, or perhaps one-sixth of an inch per annum; on an average from 6 to 12 inches thus accumulate in a century and mix with the soil to form mold; at Segesta in Sicily there is a temple about which from 5 to 8 feet of hard soil or aerial deposit has accumulated in 2,000 years, notwithstanding the washings of rain; the dust of the open air is ordinarily ascribed to the pulverization of the surfaces of roads and fields; other dust comes from the fragments of material consumed in the activity of mankind, but whence arises the dust observed by means of sunbeams in dark corners in winter, when the ground is frozen, or at sea or on the tops of rocky mountains. Just as the sea deposits particles that eventually form rocks so the air deposits a more delicate pulverulent matter.

On pages 134-136 of the first number of the second volume, of Silliman's *American Journal*, published in April, 1820, we find a reply to Professor Rafinesque by an anonymous correspondent, "X. Y. Z.," of Boston. He maintains that all dust comes from the action of the wind in raising up fine particles from the ground, and that even the dust seen at sea has the same origin, being capable of floating while being carried 1,500 miles over the Atlantic; he also asks:

If 9 feet of earth accumulate from the dust in 1800 years, then, how happens it that rocks and stones are everywhere to be met with? Are

they also agglomerations of atmospheric dust, or does the atmosphere deposit in one place clay, another gravel, another rocks?

Modern physiography answers these queries of the Boston objector very easily. The rain combines with the wind to carry all fine particles down to the ocean as fast as they are formed anywhere in the atmosphere or on the land; it is only the coarser particles and the harder soils and rocks that, with the mould, remain in sheltered places to form the earth as we know it, and all these slowly disintegrate and go to the sea. We must acknowledge it as a truth that several inches, and in many places several feet, of soil are washed into the ocean in every century, and that the accumulated weight of the ocean bed is counterbalanced by a gradual rise of the continents.

Moreover, the well recognized permanent addition to our globe, due to showers and myriads of meteors, is probably equivalent to not less than 1 inch per century for the globe, equal to 4 inches per century for the dry land surface, and all this is carried to the bottom of the ocean. As the meteors are visible 100 miles above us, it follows that either an atmosphere exists at that elevation or else an encircling ring of meteoric satellites. From a meteorological point of view, therefore, this meteoric dust is also of importance. It is this latter dust that comes down to the lower atmosphere from the very greatest heights.

As only one copy of the *Western Minerva* is known to exist (see Mr. Fox's article in *Science*, above quoted), the present Editor has secured a manuscript copy of the remarks contained therein by Rafinesque on atmospheric dust. These are in the form of a letter addressed to Governor DeWitt Clinton,<sup>1</sup> of Albany, N. Y., and dated October 1, 1820. It is in continuation of his letter previously published in the *American Journal of Science*, and although it may have only a historical value, it will nevertheless interest many of our readers, and shows that Rafinesque was certainly quite as reasonable as his critics in the views advanced by him. The geological views expressed by him are certainly crude and erroneous, but there is a modicum of truth in his idea as to the importance of dust.

We reprint herewith Professor Rafinesque's second article as it originally appeared on pages 27-29 of the *Western Minerva*, correcting only a few slips that are evidently typographical errors:

DEAR SIR: I published in 1809 [evidently 1819—C. A.] some ideas upon this subject in the *American Journal of Science*. An anonymous reply to my remarks has since appeared in the same journal, which is calculated to mislead; and as I have not been able to avail myself of the same vehicle, in order to state more fully and explain the motives of my belief in the atmospheric spontaneous production of a great part of the dusty particles floating in the air, I take the liberty to address you some additional remarks on this subject, which, should my conjectures prove correct, will form an important link in the economy of nature.

The anonymous writer contends, with the generality of authors, that these dusty particles are altogether lifted by the winds and carried everywhere. I do not deny that the winds raise the terrestrial dust and often carry it to a distance; this happens whenever the ground is dry and the winds blow; but I assert that it is impossible that this terrestrial dust should be raised above the clouds or when the ground, being totally wet or frozen, *cannot afford any*. Yet, as a dust exists in the atmosphere as far as the clouds at all times, I venture to believe, with Virey, Patrin, Deluc, and other philosophers, that there must be another independent formation of dust in the atmosphere besides the scanty terrestrial supply wafted by the winds.

To prove this assertion, I need merely refer you to the observation of a very common meteoric phenomenon, which has seldom been noticed. Look at the clouds, toward sunrise or sunset principally, when the sun is concealed behind them, and an opening happens to take place through which the sun may shine obliquely. A pyramidal beam will immediately appear, similar to the luminous and dusty beam appearing in a room into which the sun shines obliquely. This common occurrence has received the vulgar name of *sunbeams*; but it is evident

that it is not a mere beam of light, since it is not so bright or dazzling as the bright sun rays, nor is it an optical reflection of the enlightened atmosphere, since it is brighter and not azure. It must, therefore, be a beam of atmospheric dust, and its identity with the beams produced by a hole in a screen or a window in a room is evident. If several openings exist among the clouds, many beams will be seen; and this phenomenon is sometimes visible without openings, when many clouds act as screens.

It remains to prove that this phenomenon happens when there can be no terrestrial dust in the air, else it would be contended that this dust rises (like balloons) to the clouds. Choose for your observation a short time after a long and heavy rain or snow, which must have precipitated all the terrestrial dust to the ground, and you will perceive the same sunbeams under similar circumstances. Whence it must follow that this beam of dust must have preexisted above the sphere of the storm and fallen since from above the clouds; and as it can not be admitted with plausibility that any great quantity of terrestrial dust can exist permanently above the clouds, so as to be able to form immediately such immense volumes of dusty beams, or rather to fill all the space between the ground and the clouds, I think it rational to presume that this atmospheric dust is continually formed or evolved in the atmosphere and falls down after the rain to fill the vacuum.

The insight given us by modern chemistry into the gaseous formations of solid substances, will be amply sufficient to account for this spontaneous formation. We know now that sulphurated arsenic and mercury, sulphur, muriate of ammonia, etc., can be formed by the sublimation of gases; that smoke, soot, manna, volcanic productions, meteorolites, earths, and even stones or metals, etc., may be spontaneously combined by a casual meeting or mixture of gaseous emanations. It is not, therefore, difficult to conceive how dusty particles may be formed in the great chemical laboratory of our atmosphere.

A singular instance of atmospheric formation has been recorded in the travels of La Pérouse. He saw, in a storm, on the east coast of Tartary, the actual formation of a number of slender threads, similar to spider webs. The numerous instances lately ascertained of earthy rains, containing many oxides, come still nearer to the point; they only differ from the common dust, by their tenuity, color, locality, and composition. They are local phenomena and productions, while the atmospheric dust is a permanent and universal phenomenon.

It is absurd to suppose that the atmospheric dust ought to have covered the earth with a coat or stratum 27 feet thick in 1800 years, as the anonymous writer wishes to suppose. Even if the average of dust falling in one century should be ascertained to be 6 inches, it must be remembered that the greatest proportion is precipitated by rains, diluted, and carried down the streams with the rain water; a small proportion alone is mixed with the soil and *increases its bulk*. It is only in hollows, caves, corners, pits, etc., that it may accumulate to a certain extent, and compression will greatly reduce it.

It is also absurd to ask whether this dust forms all the rocks and soils on the face of the earth. But it is reasonable to suppose that it contributes to a certain degree to their increase. Our soil is formed by the decomposition of rocks, the accumulation of vegetable and animal decayed substances mixed with this atmospheric dust.

That it may in some instances form or increase substances and stony strata or conglomerations can not be denied, since this effect takes place under our eyes in cisterns and reservoirs of rain water. The earthy and dusty particles conveyed into them by the water are gradually deposited, forming concretions and stones. This is very evident in the old cisterns of the east, which have held rain water during a long period of time.

Everything, therefore, seems to indicate that there is an extensive and permanent formation (and fall) of dust in the atmosphere; that it contributes to form our soils, our alluvions, and some stones; to fill the fissures and hollows of rocks and lavas, preparing them for vegetation; and that in former times, when many of our substrata were formed, it may have been more abundant, contributing to the formation of some of those strata.

This may appear paradoxical to some persons slightly acquainted with geological and meteorological phenomena, but not unreasonable to those who observe with care. I have ventured to announce in my lectures that another formation must be added to our present geological formations, the atmospheric or meteoric formation, to which must be referred all those singular geological anomalies which puzzle so much the systematic writers, when they find extraneous stones, soils, metals, and other substances mixed or superincumbent over late or newer formations. It may perhaps in time be found necessary to ascribe to meteoric formation those extensive substrata and upper strata of sand and gravel, which can not properly be deemed alluvial nor volcanic. When our rocks were formed under water by deposition, many of their principles must have originated in the briny ocean, but some may have been derived from the atmosphere.

#### LIGHTNING FROM A CLOUDNESS SKY.

Mr. J. N. Weed, of Newburg, New York, writes as follows: On Friday evening last (August 3), myself and five others were on

<sup>1</sup> Governor Clinton was at this time President of the Literary and Philosophical Society of Albany, and numerous scientific papers published in the *American Journal of Science* were originally addressed to him and read before that Society previous to their publication.